



Intertidal Fish Inventory of San Juan Island National Historical Park (2002)

Natural Resource Technical Report NPS/NCCN/NRTR—2011/457



ON THE COVER

American Camp, San Juan National Island Historic Park.
Photograph by: S. Fradkin.

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Executive Summary

In November 2002, coastal and fisheries staff from Olympic National Park conducted a four-day inventory of intertidal fishes at San Juan Island National Historical Park. Beach seine sampling was employed in all intertidal zone habitat types associated with the coastal areas of the American and English Camp units. A total of 26 sites were sampled in both park units, with 11 sites sampled in the protected bay habitats of English Camp and 15 in the more exposed coastal habitats of American Camp. Intertidal habitat diversity was relatively low, with most areas dominated by mixed-coarse gravel and sand (American Camp) or mud/silt (English Camp) substrates. A total of 14 species were documented including various baitfish (smelt, herring, sandlance), surfperch, flatfish, sculpins, and gunnels. This project is the first effort to inventory the intertidal fishes of San Juan Island National Historical Park and only represents the assemblage structure found within the limited sampling period.

Acknowledgments

This work was made possible through National Park Service Inventory and Monitoring Program funding through the North Coast and Cascades Network of National Parks. GIS and intertidal habitat data were kindly provided by Phil Block and the People for Puget Sound through their Rapid Shoreline Inventory Program on San Juan Island. San Juan Island National Historical Park staff (D. Wahl and B. Gleason) provided logistical assistance and field help. Participating Olympic National Park staff included S. Brenkman, S. Corbett and P. Kennedy. We wish to extend a special thanks to M. Ross for kind emergency assistance in the field. This report benefitted from reviews by M. Huff and P. Crain.

Introduction

Program Scope

In 1998, Congress passed the National Parks Omnibus Management Act, which recognized the need for credible scientific information to manage parks. The following year, the National Park Service initiated the Natural Resource Challenge, which greatly expanded inventory and monitoring efforts in order to establish baseline information and to provide long-term trends in condition of National Park System resources. The resultant congressionally funded Servicewide Inventory and Monitoring (I&M) Program provides funds to park Networks, such as the North Coast and Cascades Network (NCCN), to conduct biological inventories and long-term monitoring (NPS 1999). The basic goal of the inventory portion of the program is to document through existing data and targeted field investigations the occurrence of at least 90% of the species of vertebrates and vascular plants currently estimated to occur in the park. The I&M program views inventories as iterative processes, whereby an initial effort is conducted, after which further additions and refinements to these initial inventories can be made during more in-depth investigations funded by various sources including the national program.

Objectives

The effort described in this report represents an initial effort to inventory the intertidal fishes of the San Juan Island National Historical Park (SAJH). From this inventory, the fish communities of the American Camp (north and south) and English Camp shorelines were compared and the number of possible species present in the overall study area at the time of sampling were estimated. This inventory does not represent an accurate assessment of fish assemblage structure across different seasons or between years; rather it represents the assemblage structure found during the limited sampling period.

Site Description

San Juan Island National Historical Park is a 1,752-acre unit of the National Park Service located on San Juan Island along the Haro Strait in northwestern Washington, between Vancouver Island and the Washington State mainland. The park was established in 1966 to commemorate the “Pig War” crisis of 1854, a boundary dispute between Great Britain and the United States. The park is comprised of two disjunctive units representing the sites of American and English military emplacements during the crisis. The two units include approximately six miles of shoreline which is associated with adjacent intertidal habitat. The English Camp unit consists of 529 acres located on Garrison Bay and Westcott Bay (Figure 1) at the northern end of San Juan Island. Most of the intertidal habitat in this protected bay area is mud with a small amount of rocky outcrops and gravel beach (Table 1). The American Camp Unit contains 1,223 acres spanning the peninsula between Griffin Bay and the Haro Strait near the southeastern tip of the island. The southern shore mainly consists of mixed-sized gravels and sand, with a small section of rocky shoreline at the western end of the unit. The northern shore consists mainly of mixed-sized gravel substrates and mud, with no rocky shoreline habitat, and contains three tidal lagoons: Old Town, Jakles, and Third.

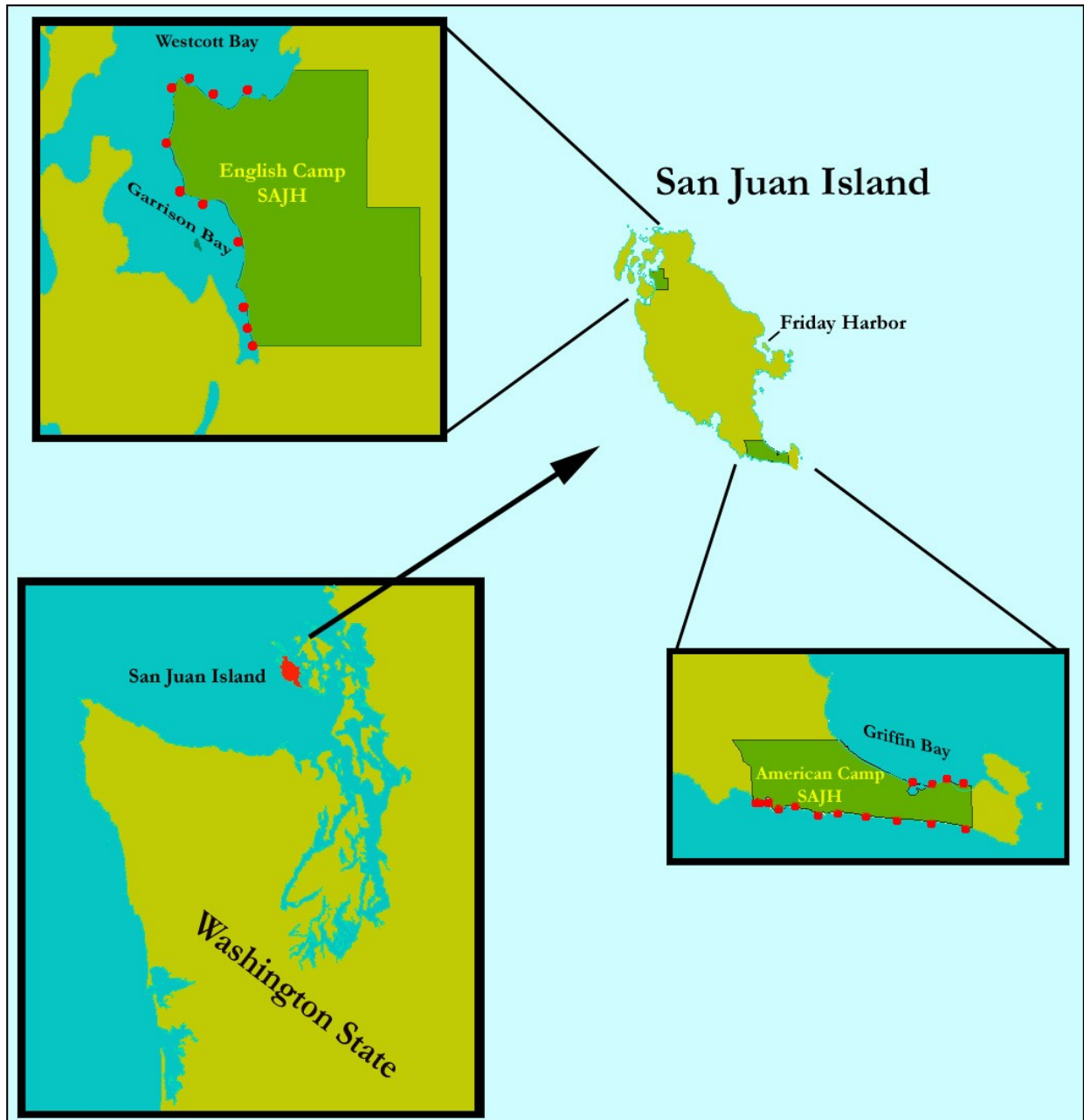


Figure 1. Location of San Juan Island National Historical Park in northwestern Washington State. American Camp and English Camp units are on opposite ends of San Juan Island. Red circles denote beach seine sampling locations.

Table 1. Proportion of intertidal habitat types present in the three shorelines of San Juan Island National Historical Park sampling sites. Data are derived from People for Puget Sound's Rapid Shoreline Inventory GIS Database (2002).

Habitat Type	American Camp North	American Camp South	English Camp
Rock/Boulder		30%	5%
Cobble	30%	2%	
Mixed Gravels	49%	52%	8%
Sand		16%	
Mud/Silt	21%		87%
<i>Total</i>	100%	100%	100%

Methods

San Juan Island National Historical Park intertidal fish sampling was conducted by Olympic National Park (OLYM) staff on November 5-7, 2002. Representative habitats on the southern shoreline of American Camp and the shoreline of English Camp were systematically sampled at approximate regular intervals (20-40 m). The northern shore of American Camp was incompletely sampled due to mechanical difficulties with the Zodiac skiff on the final day of scheduled sampling. Coordinates of all locations sampled appear in Appendix 1. Because all intertidal areas of SAJH are relatively protected compared to the exposed coastlines found at OLYM, all habitat types were successfully sampled. However, on the shores associated with SAJH, very few, if any, tidepools exist. As such, all intertidal sampling was conducted using a beach seine specially designed for use on rocky shores. The 120 ft variable mesh seine consists of 33 ft wings of 1.24 inch white mesh nylon and a 54 ft center section of 0.25 inch green nylon mesh. The 2.5 ft leading edge (lead line) of the 10 ft deep central panel is constructed of hypolon material enabling the seine to slide over obstacles such as rocks, etc. The seine was set using a “round haul” technique (Figure 2). One end of the seine was held on the beach with the opposite end attached to a 15 ft Zodiac skiff. The skiff then backed perpendicular from the shore until the entire net was out. The skiff then headed for shore, forming an arc, closing the seine approximately 54 ft from the starting point. The seine was then pulled to shore by hand, where all fish were identified to species level and enumerated. Similar nets used in this fashion are approximately 95% efficient at capturing epibenthic fish (i.e. those living on the surface of the ocean bottom) within the seined area (Murphy et al. 2000). All sampling occurred diurnally when tidal elevations were between 5.1 and 8.8 ft above mean lower low water. At each sampling site, substrate type was qualitatively determined and compared with the GIS database compiled by the People for Puget Sound Rapid Shoreline Inventory Program.



Figure 2. Sampling at the English Camp unit of San Juan Island National Historical Park.

For each species captured, representative voucher specimens were collected and preserved in the field in 70% ethanol. Once back at the OLYM Lake Crescent Natural Resources Laboratory, all voucher specimen identities were verified by methods described by Clemens and Wilby (1946), Hart (1973), Lea and Miller (1972), and Lamb and Edgell (1986) and were fixed in formalin, labeled and stored in 95% ethanol. All specimens have been accessioned into the OLYM collection.

Comparisons of intertidal fish community structure were made between sites (American Camp South, American Camp North, and English Camp). Data were analyzed using the multivariate methods of Clarke (1993), Clarke and Warwick (2001) and PRIMER software (Clarke and Gorley, 2001). Fish frequency and abundance data were grouped by site and fourth root

transformed to accommodate high and low values in subsequent analyses. Bray-Curtis similarities were generated and non-metric multidimensional scaling (MDS) was performed. Similarity percentage analyses (SIMPER) were used to identify fish taxa contributing most to the average similarity within groups. Analysis of similarity (ANOSIM) tested the significant differences between sites.

Results and Discussion

A total of 26 sites were sampled within English Camp (EC), American Camp South (ACS), and American Camp North (ACN), resulting in the documentation of 14 intertidal fish species. These species included baitfish (smelt herring and sand lance), surfperch, flatfish, gunnels, and sculpin (Appendix 2). Representative species found are illustrated in Figure 3.

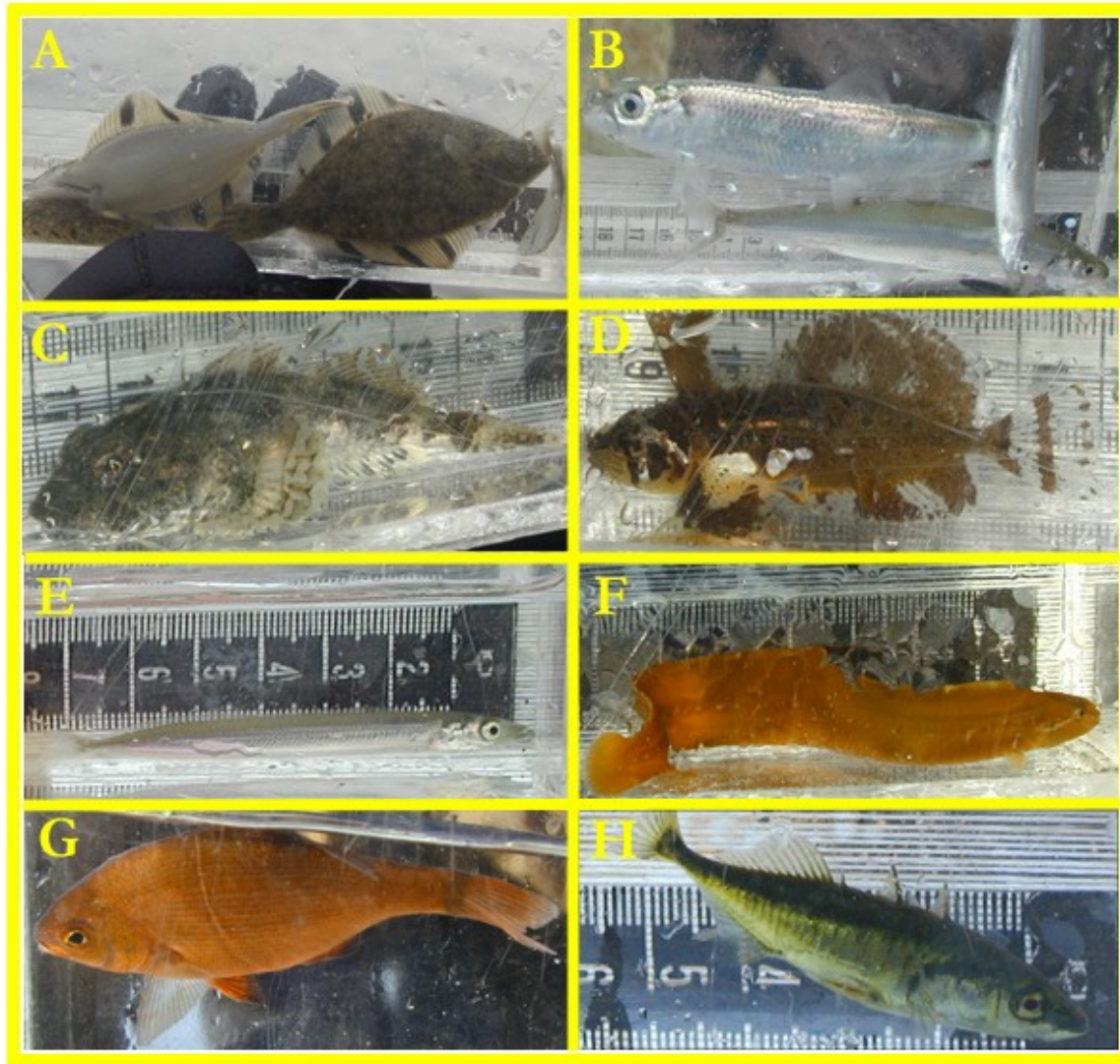


Figure 3. Representative species sampled during the San Juan Island National Historic Park intertidal fish inventory in November 2002. A) Starry flounder (*Platichthys stellatus*). B) Pacific herring (*Culpae hareus pallasii*) top and California surf smelt (*Hypomesus pretiosus*) bottom. C) Buffalo sculpin (*Enophrys bison*). D) Silverspotted sculpin (*Blepsias cirrhosus*). E) Pacific sand lance (*Ammodytes hexapterus*). F) Penpoint gunnel (*Apodichthys flavidus*). G) Juvenile striped surf perch (*Embiotoca lateralis*). H) Three-spine stickleback (*Gasterosteus aculeatus*).

A species area curve based on sampling data and calculated by PRIMER software (Figure 4) illustrates an asymptotic approach at the approximate sampling effort exerted in the inventory. This result suggests that during the fall of 2002, close to 90% of the species susceptible to capture by beach seining were documented at SAJH. During other seasons additional or different species may inhabit the SAJH shoreline, however such seasonal sampling was not in the scope of this initial inventory. Additionally, other sampling techniques may yield further species during the fall and other seasons. The intertidal zone is a harsh environment to work in though, and few established techniques currently exist (Gibson 1999). In habitats like those found at SAJH, beach seining the major viable technique.

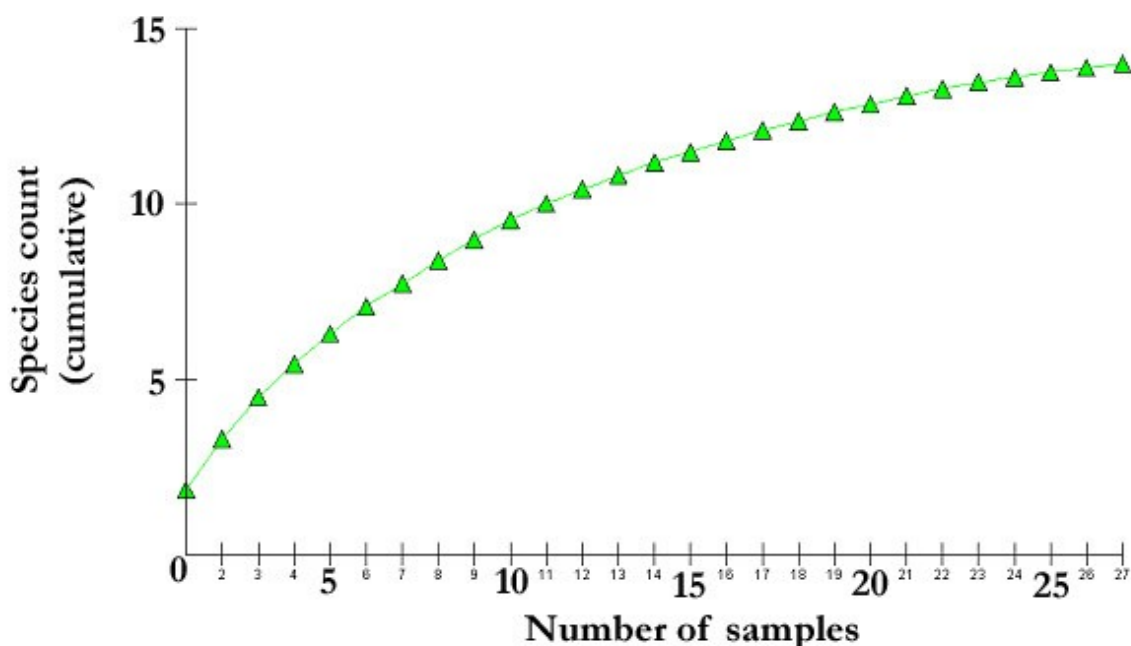


Figure 4. Species area curve for both the English and American Camp units of San Juan Island National Historical Park.

An Analysis of Similarity (ANOSIM) showed intertidal fish community structure to be significantly different between each of the three SAJH unit areas (Table 2). Non-metric multidimensional scaling illustrates these differences (Figure 5). At EC the dominant species group consisted of surf smelt and starry flounder, while at ACN the dominant species group consisted of three-spine stickleback, buffalo sculpin, and tidepool sculpin. At ACS the dominant species group was comprised of surf smelt, pacific sandlance, penpoint gunnel, pacific herring, and striped surf perch (Table 3). These results are consistent with habitat (Table 1) and exposure differences between the SAJH unit areas. The EC shoreline is highly protected within Garrison and Westcott Bays and is dominated by soft sediment substrates. This habitat favors larval baitfish and certain flatfish. The ACN shoreline is moderately protected on the larger Griffin Bay and is dominated by mixed-gravels and larger cobbles. The ACS shoreline is exposed to the Strait of Juan de Fuca and oceanic swells traversing its length. The relatively more complex habitat composed of rocky outcrop and mixed-gravel substrates can be expected to host a higher diversity of organisms due to its heterogeneity and dynamic physical environment.

Table 2. Analysis of similarities (ANOSIM) pairwise tests of San Juan Island National Historical Park locations intertidal fish communities. (EC = English Camp, ACS = American Camp southern shore, ACN = American Camp northern shore)

Groups	R Statistic	P value	Possible Permutations	Actual Permutations	Number Observed
EC, ACS	0.463	0.001	293930	999	0
EC, ACN	0.752	0.002	455	455	1
ACS, ACN	0.245	0.023	220	220	5

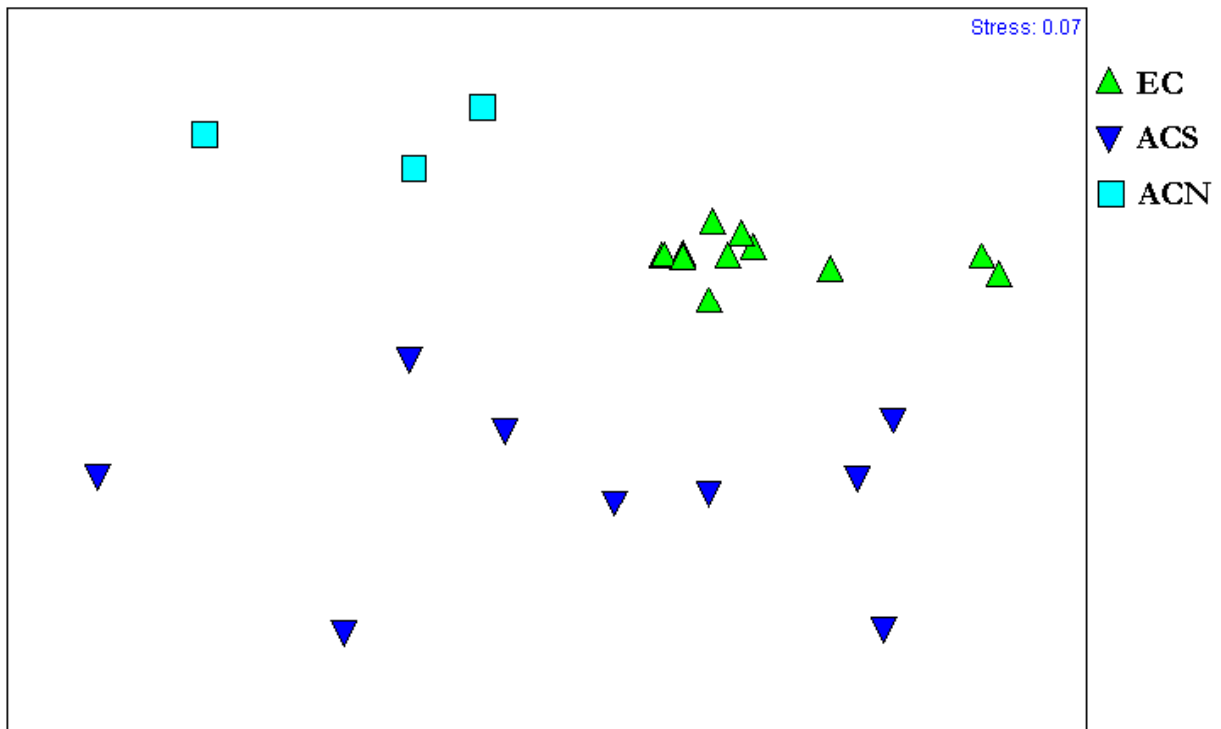


Figure 5. Non-metric Multidimensional Scaling (MDS) ordination from Bray-Curtis similarities computed for fourth-root transformed species abundances at each sampling site (MDS stress = 0.07). Unique symbols denote sampling sites within San Juan Island National Historical Park unit areas (EC = English Camp, ACS = American Camp southern shore, ACN = American Camp northern shore).

Table 3. Intertidal fish species contribution to community structure at each San Juan Island National Historical Park unit area as determined by ANOSIM. (EC = English Camp, ACS = American Camp southern shore, ACN = American Camp northern shore)

Area	Species Code	Avg. Abundance	Avg. Similarity	Similarity SD	% Contribution	Cumulative Percent
EC	HYPR	180.33	44.55	1.37	80.67	80.67
	PLST	1.08	7.68	0.47	13.91	94.58
ACS	HYPR	0.33	3.28	0.29	26.43	26.43
	AMHE	68.78	2.81	0.26	22.64	49.07
	APFL	0.33	2.80	0.29	22.55	71.61
	CLHA	2.00	1.38	0.17	11.11	82.72
	EMLA	0.67	1.00	0.17	8.06	90.78
	GAAC	1.33	15.45	0.58	43.45	43.45
ACN	ENBI	0.67	10.05	0.58	28.28	71.72
	LIFL	0.67	10.05	0.58	28.28	100

Baitfish (i.e. surf smelt, pacific herring, pacific sandlance) play a major role in the foodweb structure of nearshore marine ecosystems, and are major food sources for Pacific salmonids and rockfish (Lamb and Edgell 1986). Intertidal areas are important spawning and nursery grounds for baitfish. All SAJH park unit areas contained baitfish during this inventory. The presence of larval baitfish in EC and ACS suggest that these areas may be spawning grounds and also serve as nursery areas. No juvenile rockfish (e.g. *Sebastes spp.*) were found during this inventory suggesting that the intertidal areas of SAJH are not rockfish nursery areas.

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Appendix 1: UTM Coordinate Location of Sampling Sites

Park Unit	Location Code	Habitat Type	UTM E	UTM N
American Camp South	ACS-1	Rock/Boulder	498073.32	5367093.83
	ACS-2	Rock/Boulder	498193.24	5367093.83
	ACS-3	Rock/Boulder	498334.23	5367123.94
	ACS-4	Sand	498424.55	5366863.03
	ACS-5	Rock/Boulder	498765.73	5366933.49
	ACS-6	Rock/Boulder	499257.44	5366762.68
	ACS-7	Mixed gravel	499608.66	5366832.93
	ACS-8	Mixed gravel	500110.41	5366782.75
	ACS-9	Mixed gravel	500282.75	5366702.47
	ACS-10	Mixed gravel	501394.87	5366642.26
	ACS-11	Mixed gravel	501926.72	5366511.81
American Camp North	ACN-1	Mixed gravel	500873.06	5367485.2
	ACN-2	Mixed gravel	501284.49	5367404.92
	ACN-3	Cobble	501555.43	5367545.41
	ACN-4	Cobble	501886.58	5367445.06
English Camp	EC-1	Mud/Silt	489092.27	5380568.62
	EC-2	Mud/Silt	489070.29	5380711.55
	EC-3	Mud/Silt	489048.3	5380794.01
	EC-4	Mud/Silt	489009.81	5381211.81
	EC-5	Mud/Silt	488611.26	5381474.64
	EC-6	Mud/Silt	488745.94	5381387.72
	EC-7	Mud/Silt	488480.27	5381728.56
	EC-8	Mud/Silt	488520.55	5382063.89
	EC-9	Mixed gravel	488630.5	5382080.38
	EC-10	Mud/Silt	488817.41	5381975.93
	EC-11	Mud/Silt	489059.29	5382014.42

Appendix 2: Species Abundance and Distribution Data by Sampling Location

Location	Site	Code	Common Name	Scientific Name	# In Net Haul
American Camp North	ACN1	ENBI	buffalo sculpin	<i>Enophrys bison</i>	1
American Camp North	ACN1	GAAC	three spine stickleback	<i>Gasterosteus aculeatus</i>	3
American Camp North	ACN1	LIFL	tidepool sculpin	<i>Oligocottus maculosus</i>	1
American Camp North	ACN3	BLCI	silverspotted sculpin	<i>Blepsias cirrhosus</i>	3
American Camp North	ACN3	ENBI	buffalo sculpin	<i>Enophrys bison</i>	1
American Camp North	ACN3	LIFL	tidepool sculpin	<i>Oligocottus maculosus</i>	1
American Camp North	ACN4	GAAC	three spine stickleback	<i>Gasterosteus aculeatus</i>	1
American Camp South	ACS1	APFL	penpoint gunnel	<i>Apodichthys flavidus</i>	1
American Camp South	ACS1	CYAG	shiner perch	<i>Cymatogaster aggregata</i>	1
American Camp South	ACS1	EMLA	striped surf perch	<i>Embiotoca lateralis</i>	3
American Camp South	ACS1	EMLA	striped surf perch	<i>Embiotoca lateralis</i>	1 (yoy)
American Camp South	ACS1	GAAC	three spine stickleback	<i>Gasterosteus aculeatus</i>	1
American Camp South	ACS2	EMLA	striped surf perch	<i>Embiotoca lateralis</i>	2
American Camp South	ACS2	SYGI	manacled sculpin	<i>Synchirus gilli</i>	1
American Camp South	ACS3	AMHE	pacific sandlance	<i>Ammodytes hexapterus</i>	1
American Camp South	ACS3	APFL	penpoint gunnel	<i>Apodichthys flavidus</i>	1
American Camp South	ACS3	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	1
American Camp South	ACS3	ISIS	butter sole	<i>Isopsetta isolepsis</i>	1
American Camp South	ACS4	APFL	penpoint gunnel	<i>Apodichthys flavidus</i>	1
American Camp South	ACS5	AMHE	pacific sandlance	<i>Ammodytes hexapterus</i>	102
American Camp South	ACS5	GAAC	three spine stickleback	<i>Gasterosteus aculeatus</i>	1
American Camp South	ACS6	AMHE	pacific sandlance	<i>Ammodytes hexapterus</i>	516
American Camp South	ACS6	CYAG	shiner perch	<i>Cymatogaster aggregata</i>	1
American Camp South	ACS6	PLST	starry flounder	<i>Platichthys stellatus</i>	1
American Camp South	ACS8	CLHA	pacific herring	<i>Harengus pallasii</i>	1
American Camp South	ACS10	CLHA	pacific herring	<i>Harengus pallasii</i>	17
American Camp South	ACS10	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	1
American Camp South	ACS11	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	100 (larval)

Appendix 2: Species Abundance and Distribution Data by Sampling Location (continued).

Location	Site	Code	Common Name	Scientific Name	# In Net Haul
English Camp	EC1	GAAC	three spine stickleback	<i>Gasterosteus aculeatus</i>	1
English Camp	EC1	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	150 (larval)
English Camp	EC2	GAAC	three spine stickleback	<i>Gasterosteus aculeatus</i>	1
English Camp	EC2	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	400 (larval)
English Camp	EC2	LEAR	staghorn sculpin	<i>Leptocottus armatus</i>	1
English Camp	EC2	LIFL	tidepool sculpin	<i>Oligocottus maculosus</i>	1
English Camp	EC3	GAAC	three spine stickleback	<i>Gasterosteus aculeatus</i>	1
English Camp	EC3	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	300 (larval)
English Camp	EC3	LEAR	staghorn sculpin	<i>Leptocottus armatus</i>	2
English Camp	EC4	GAAC	three spine stickleback	<i>Gasterosteus aculeatus</i>	1
English Camp	EC4	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	100 (larval)
English Camp	EC5	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	150 (larval)
English Camp	EC6	PLST	starry flounder	<i>Platichthys stellatus</i>	5 (yoy)
English Camp	E7	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	15 (larval)
English Camp	EC7	PLST	starry flounder	<i>Platichthys stellatus</i>	1
English Camp	EC8	PLST	starry flounder	<i>Platichthys stellatus</i>	2 (yoy)
English Camp	EC9	CLHA	pacific herring	<i>Harengus pallasii</i>	1
English Camp	EC9	GAAC	three spine stickleback	<i>Gasterosteus aculeatus</i>	1
English Camp	EC9	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	99
English Camp	EC9	PLST	starry flounder	<i>Platichthys stellatus</i>	2 (yoy)
English Camp	EC10	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	150 (larval)
English Camp	EC10	PLST	starry flounder	<i>Platichthys stellatus</i>	2
English Camp	EC11	HYPR	surf smelt	<i>Hypomesus pretiosus</i>	500 (larval)
English Camp	EC11	PLST	starry flounder	<i>Platichthys stellatus</i>	1

Note: Larval denotes all specimens were larval fish. YOY denotes that specimens were new young of the year.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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